FIG.1

SEARCHED ITEM	ANSWER
10001	X
10010	Y
⋮	⋮

FIG.2

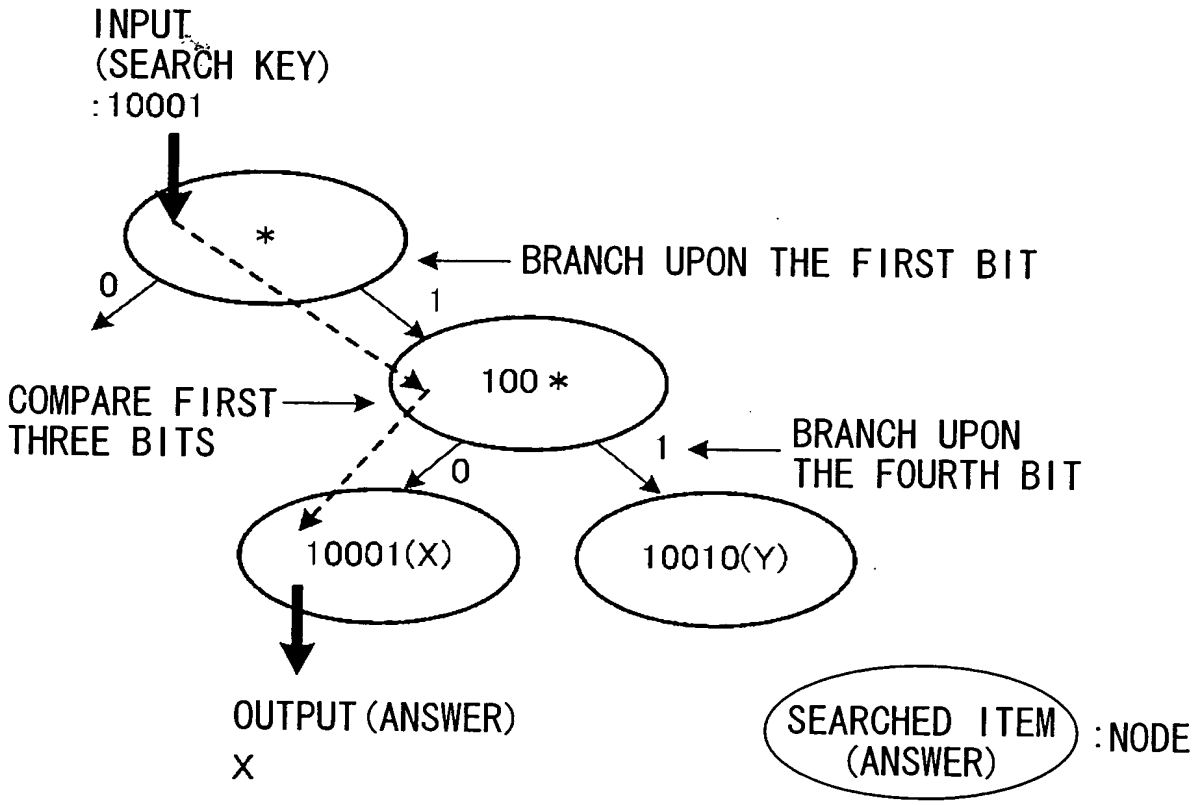


FIG.3

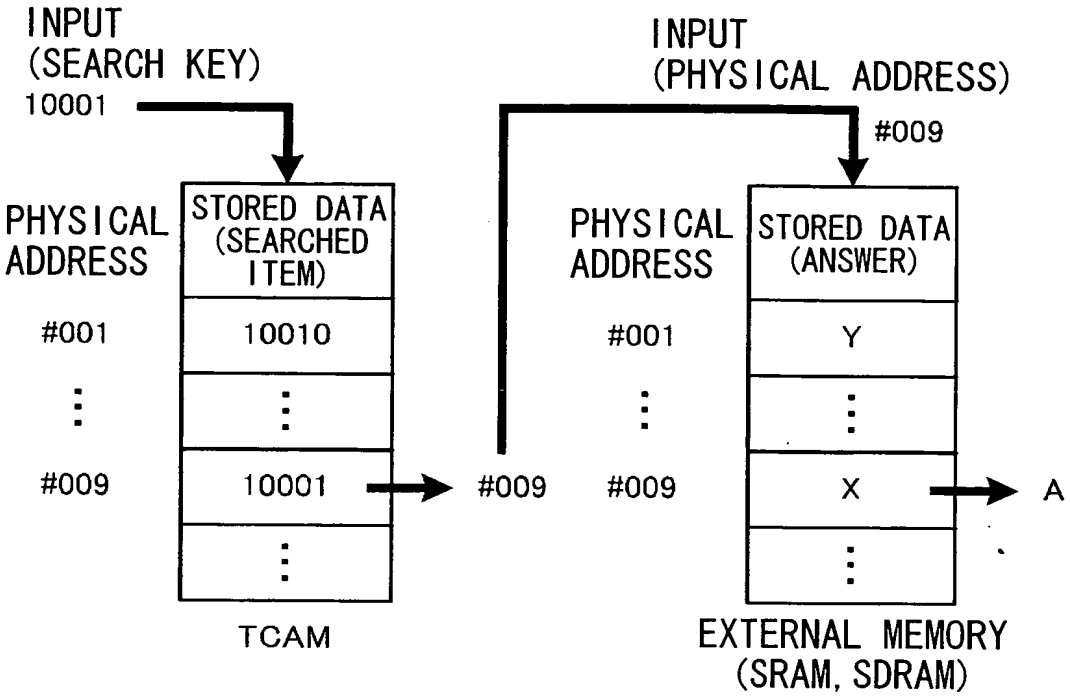

INPUT
(SEARCH KEY)
10001
PHYSICAL ADDRESS
STORED DATA (SEARCHED ITEM)
#001
10010
#009
10001
TCAM
#009
INPUT
(PHYSICAL ADDRESS)
#009
PHYSICAL ADDRESS
STORED DATA (ANSWER)
#001
Y
#009
X
A
EXTERNAL MEMORY
(SRAM, SDRAM)

FIG.4

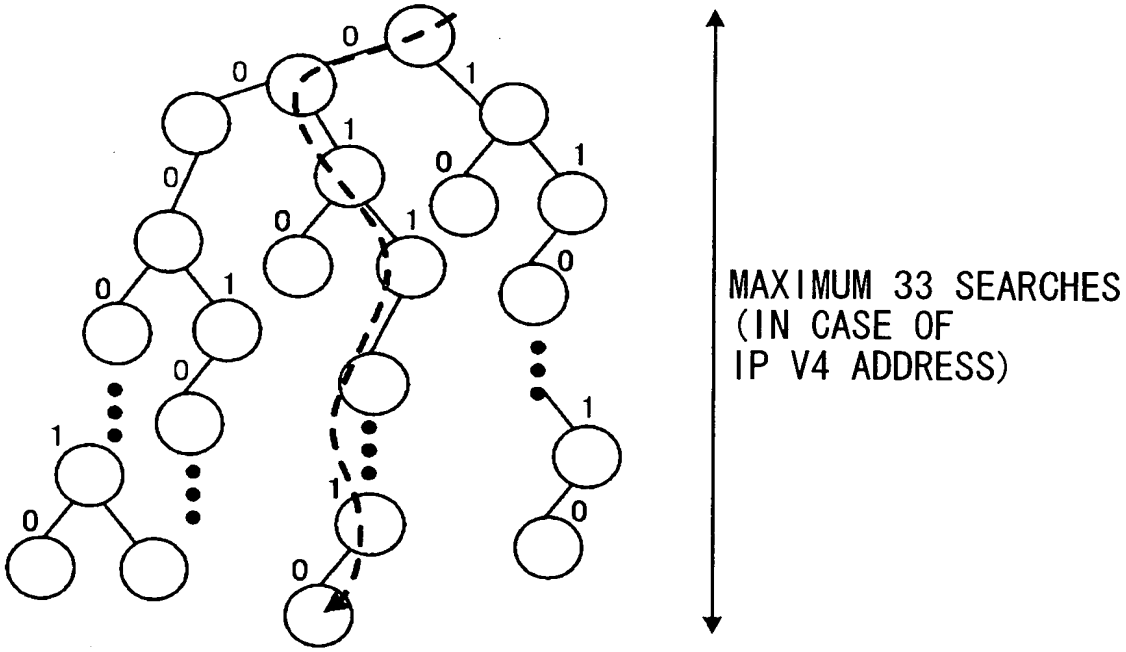

MAXIMUM 33 SEARCHES
(IN CASE OF
IP V4 ADDRESS)

FIG.5

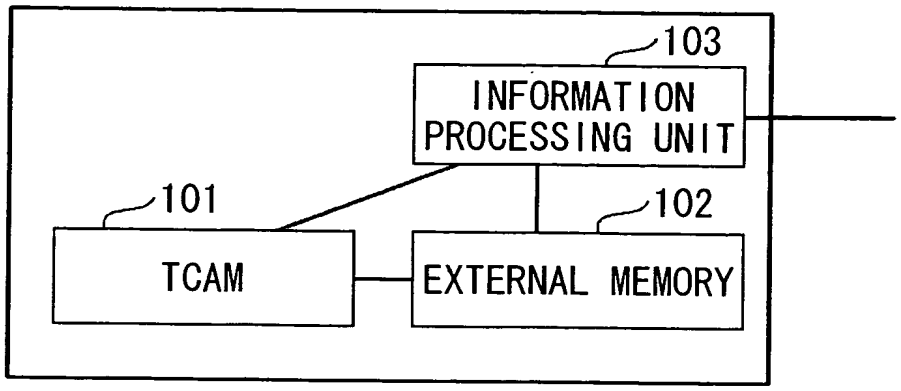

103
INFORMATION PROCESSING UNIT
101
102
TCAM
EXTERNAL MEMORY

FIG.6

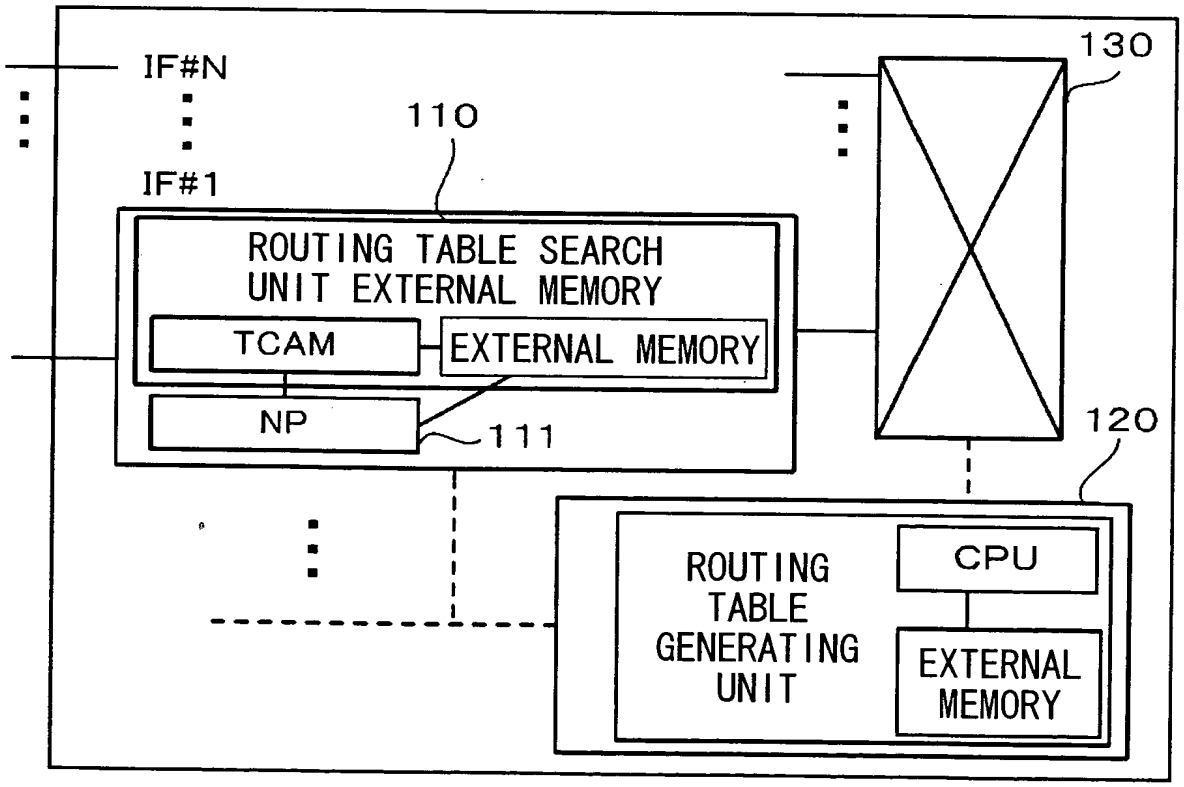

IF#N
IF#1
110
130
ROUTING TABLE SEARCH UNIT EXTERNAL MEMORY
TCAM
EXTERNAL MEMORY
NP
111
120
ROUTING TABLE GENERATING UNIT
CPU
EXTERNAL MEMORY

FIG.7

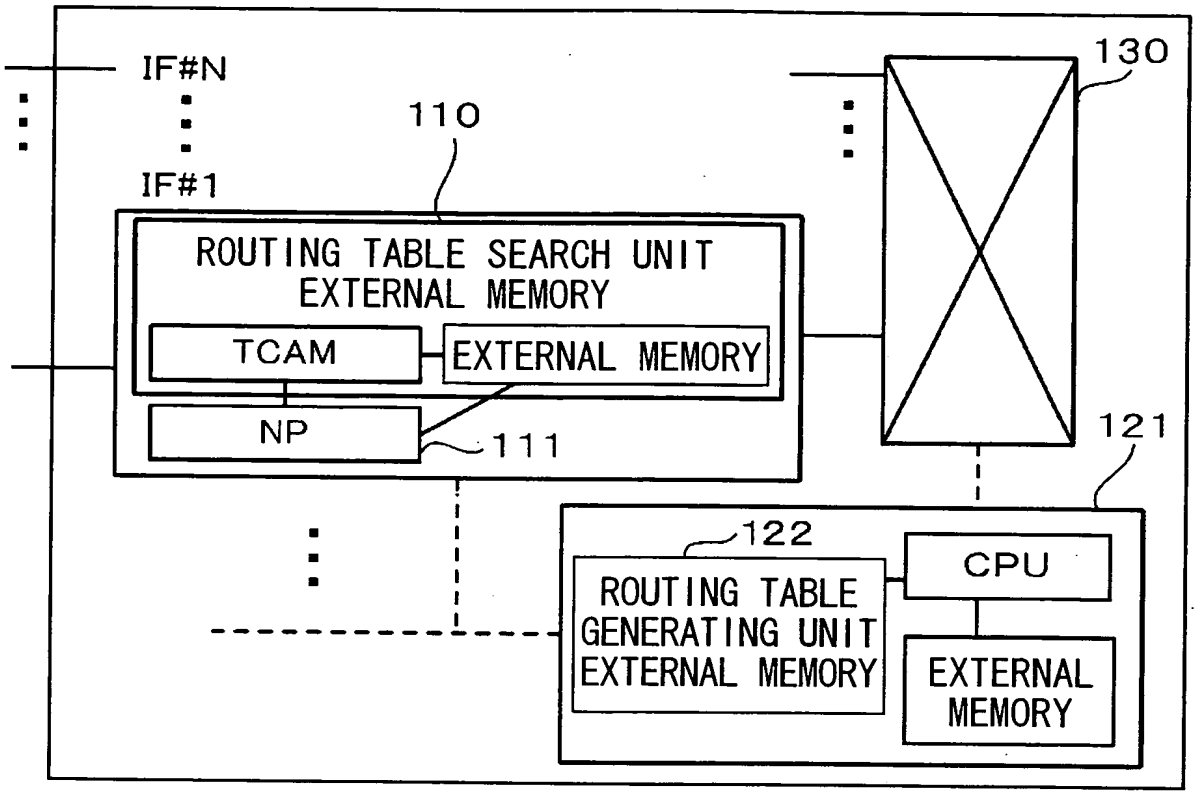

IF#N
IF#1
110
130
ROUTING TABLE SEARCH UNIT
EXTERNAL MEMORY
TCAM
EXTERNAL MEMORY
NP
111
121
122
ROUTING TABLE
GENERATING UNIT
EXTERNAL MEMORY
CPU
EXTERNAL
MEMORY

FIG.8

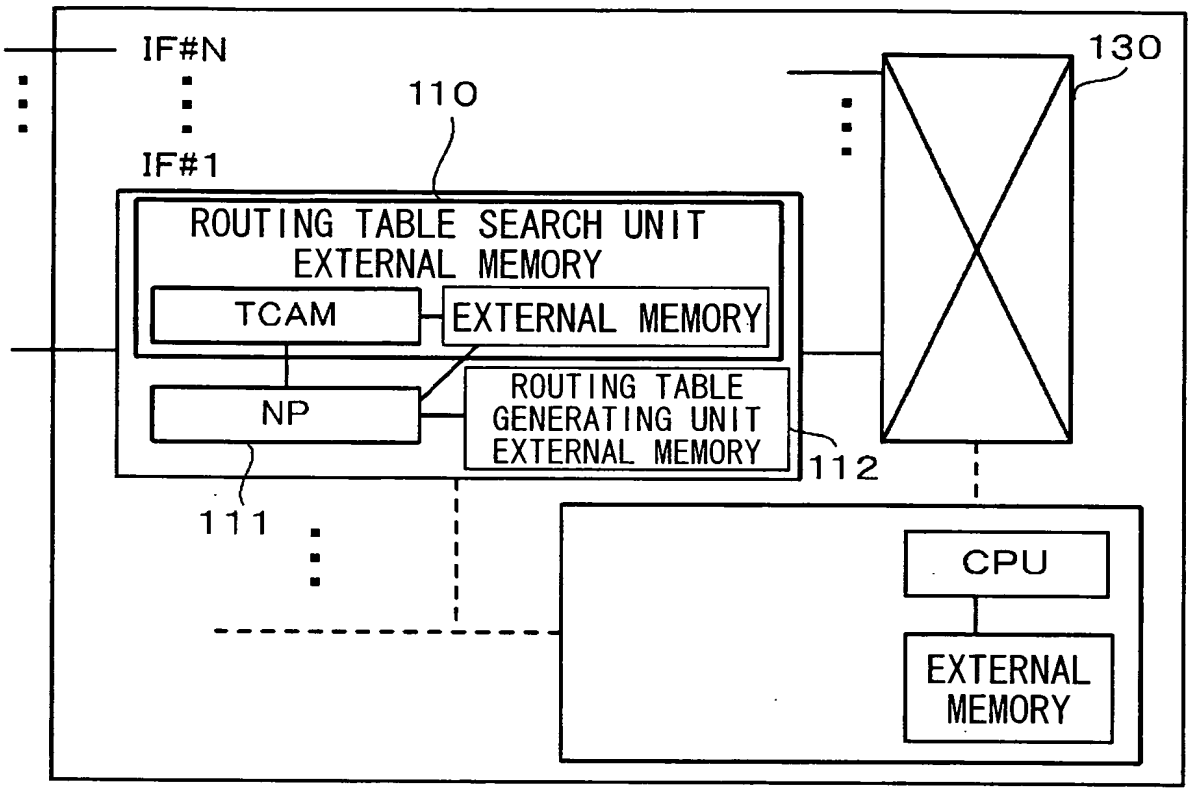

IF#N
IF#1
110
130
ROUTING TABLE SEARCH UNIT
EXTERNAL MEMORY
TCAM
EXTERNAL MEMORY
NP
ROUTING TABLE
GENERATING UNIT
EXTERNAL MEMORY
112
111
CPU
EXTERNAL
MEMORY

FIG.9

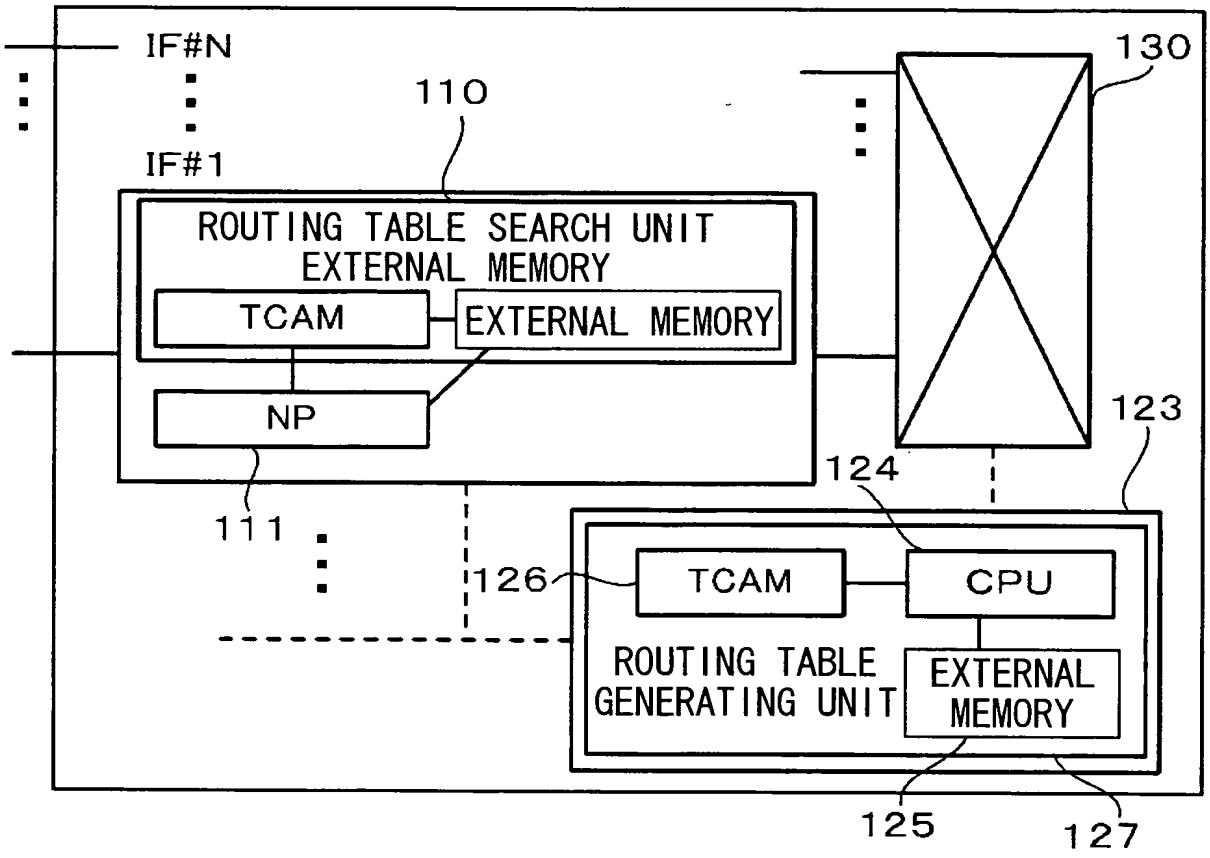

IF#N
IF#1
110
130
ROUTING TABLE SEARCH UNIT
EXTERNAL MEMORY
TCAM
EXTERNAL MEMORY
NP
111
123
124
126
TCAM
CPU
ROUTING TABLE
GENERATING UNIT
EXTERNAL
MEMORY
125
127

FIG.10

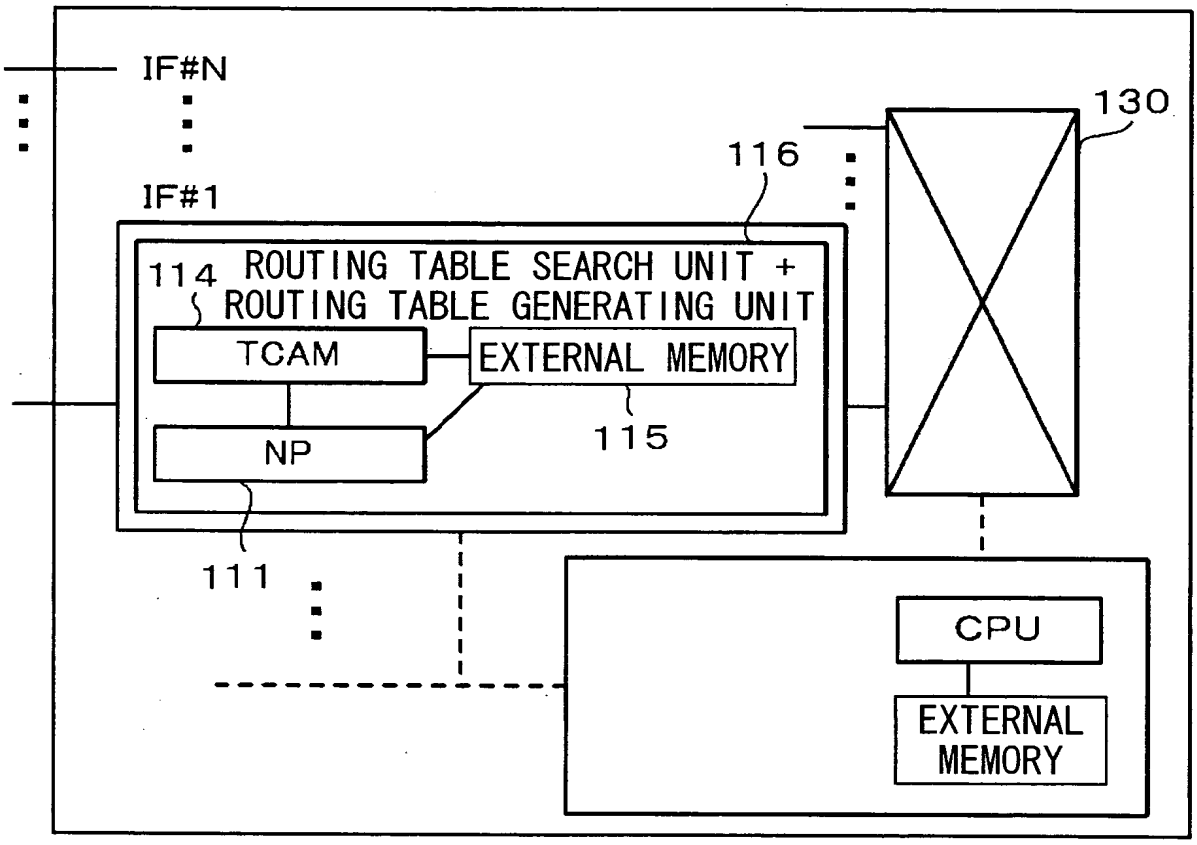

IF#N
IF#1
130
116
114
ROUTING TABLE SEARCH UNIT +
ROUTING TABLE GENERATING UNIT
TCAM
EXTERNAL MEMORY
115
NP
111
CPU
EXTERNAL MEMORY

FIG.11

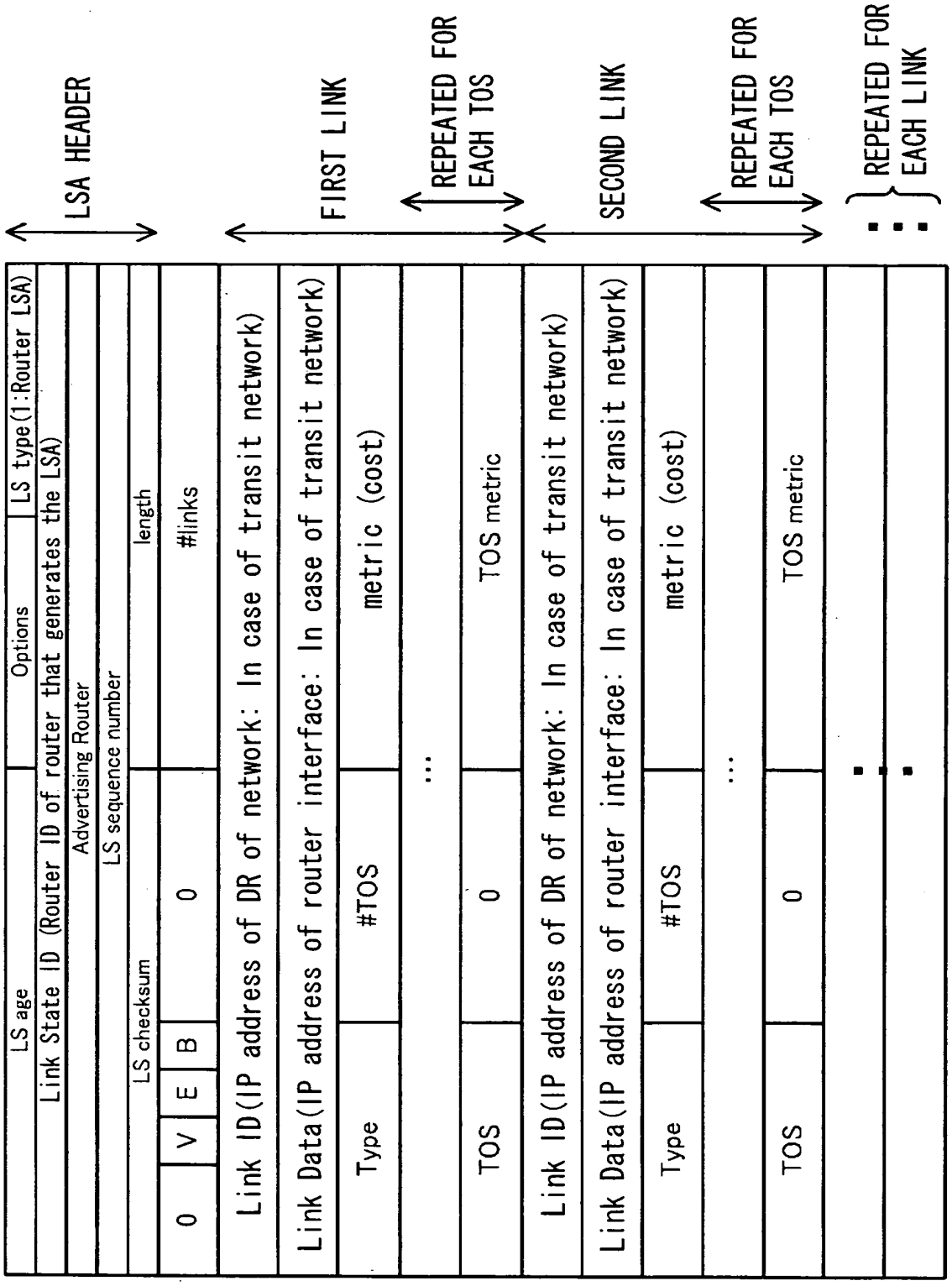
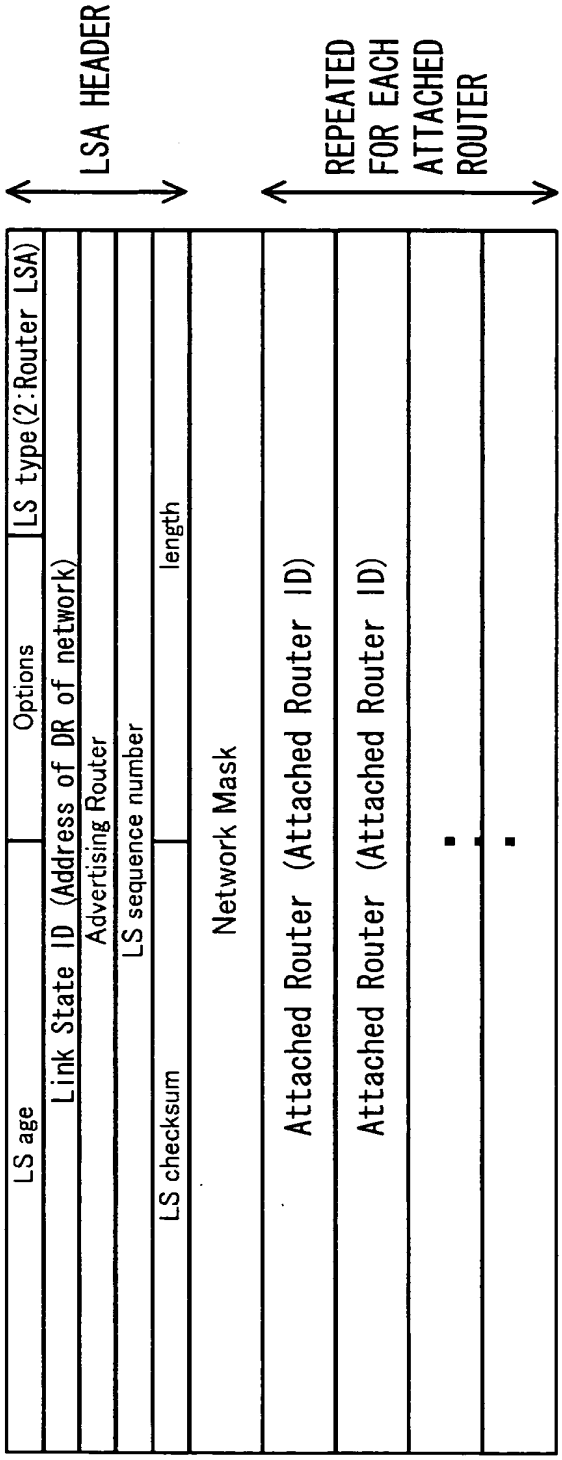

LSA HEADER
FIRST LINK
REPEATED FOR EACH TOS
SECOND LINK
REPEATED FOR EACH TOS
REPEATED FOR EACH LINK
LS age
Options
LS type(1:Router LSA)
Link State ID (Router ID of router that generates the LSA)
Advertising Router
LS sequence number
LS checksum
length
0
V
E
B
0
#links
Link ID(IP address of DR of network: In case of transit network)
Link Data(IP address of router interface: In case of transit network)
Type
#TOS
metric (cost)
...
TOS
0
TOS metric
Link ID(IP address of DR of network: In case of transit network)
Link Data(IP address of router interface: In case of transit network)
Type
#TOS
metric (cost)
...
TOS
0
TOS metric

FIG.12


LSA HEADER
REPEATED FOR EACH ATTACHED ROUTER
LS age
Options
LS type (2:Router LSA)
Link State ID (Address of DR of network)
Advertising Router
LS sequence number
LS checksum
length
Network Mask
Attached Router (Attached Router ID)
Attached Router (Attached Router ID)

10/531436

FIG.13

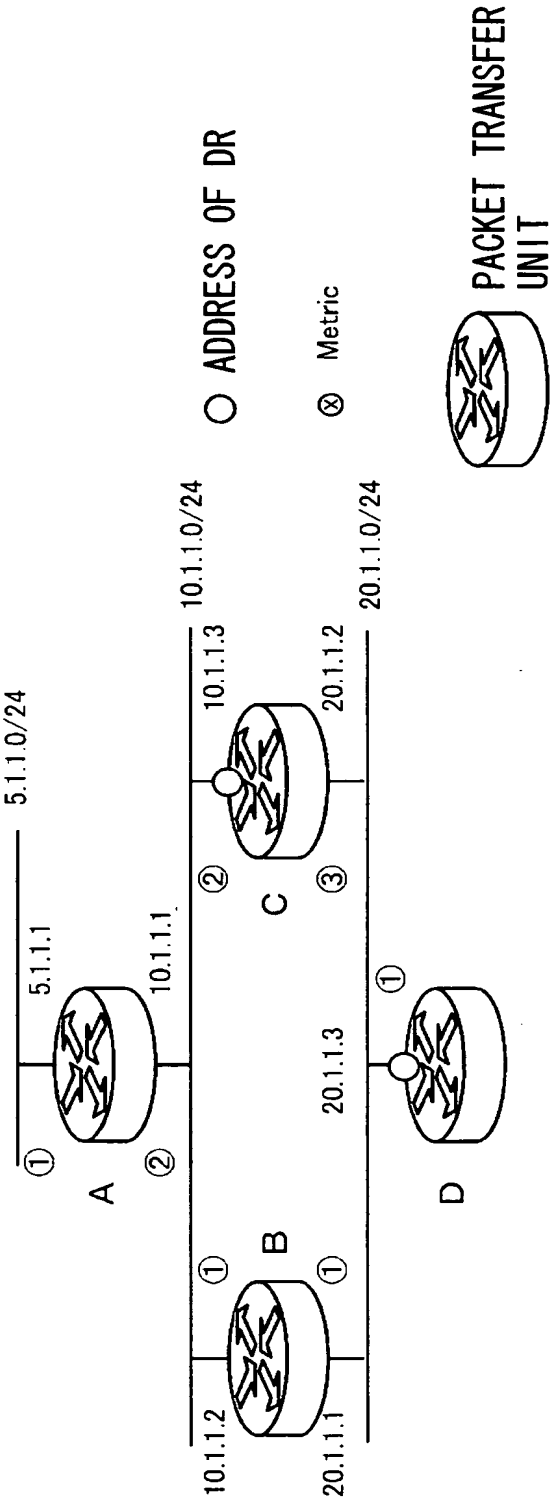


FIG.14

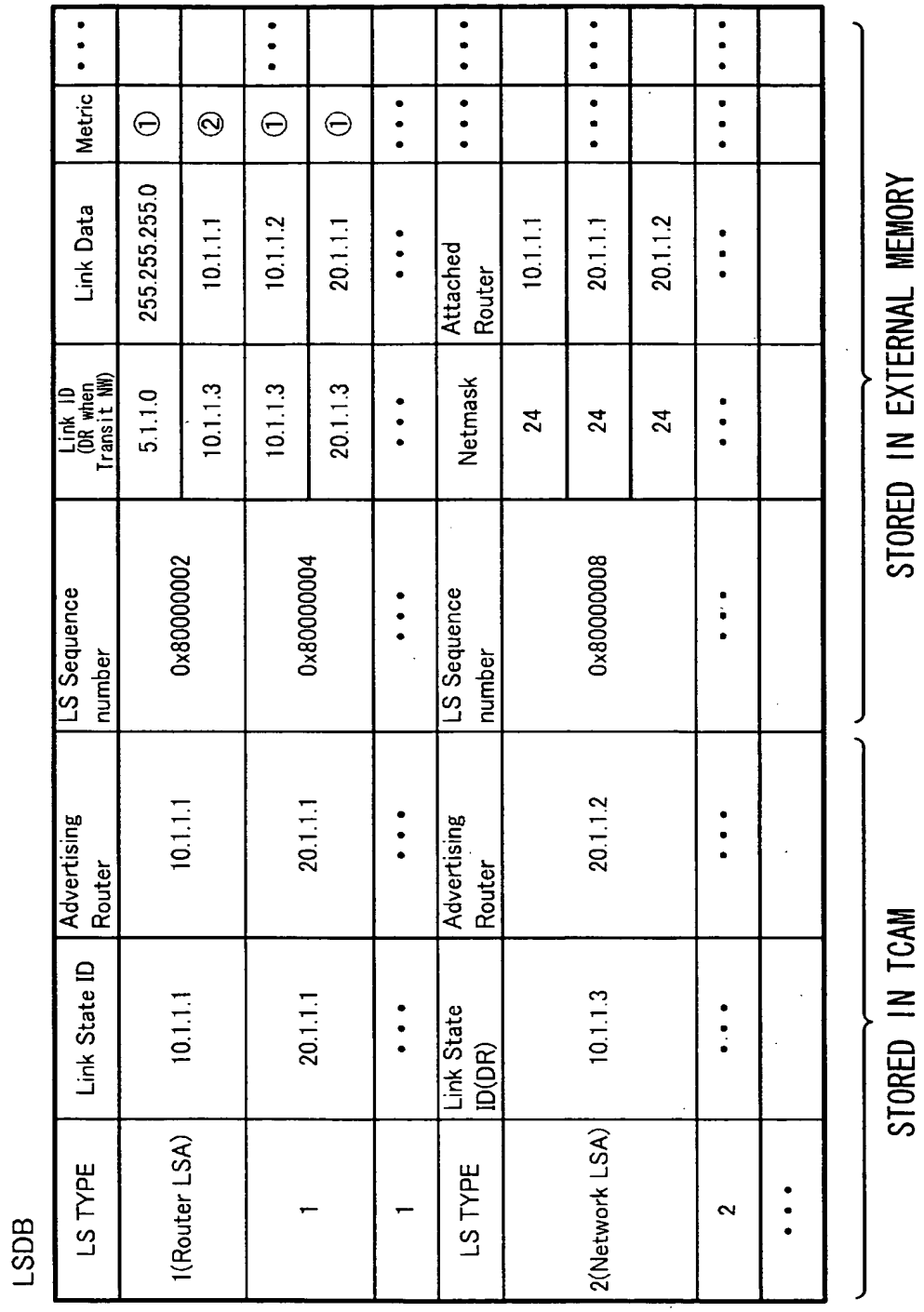

LSDB
LS TYPE
Link State ID
Advertising Router
LS Sequence number
Link ID (OR when Transit NW)
Link Data
Metric
1(Router LSA)
10.1.1.1
10.1.1.1
0x80000002
5.1.1.0
255.255.255.0
①
10.1.1.3
10.1.1.1
②
1
20.1.1.1
20.1.1.1
0x80000004
10.1.1.3
10.1.1.2
①
20.1.1.3
20.1.1.1
①
1
• • •
• • •
• • •
• • •
• • •
LS TYPE
Link State ID(DR)
Advertising Router
LS Sequence number
Netmask
Attached Router
• • •
2(Network LSA)
10.1.1.3
20.1.1.2
0x80000008
24
10.1.1.1
24
20.1.1.1
• • •
24
20.1.1.2
2
• • •
• • •
• • •
• • •
• • •
• • •
STORED IN TCAM
STORED IN EXTERNAL MEMORY

FIG.15

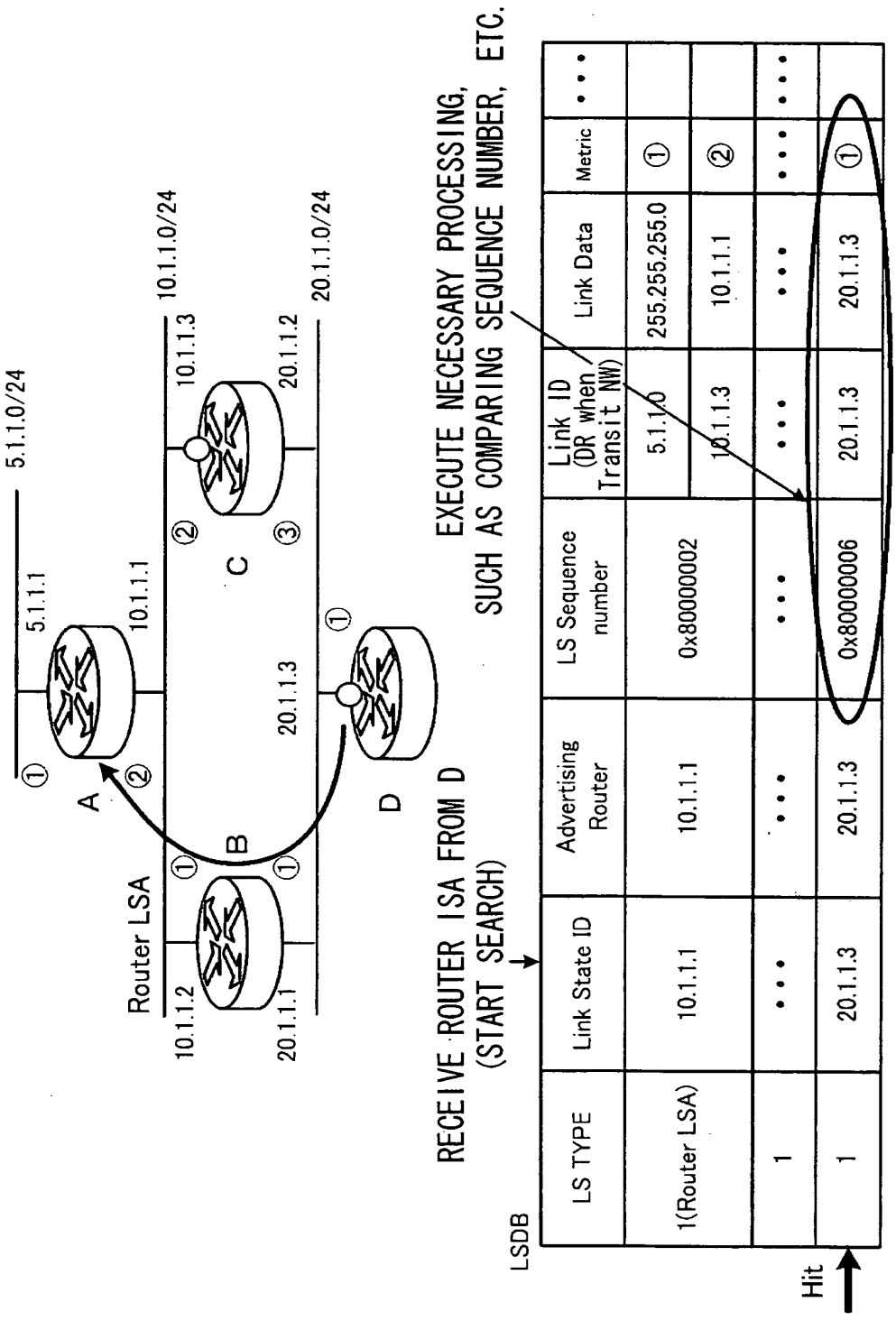

5.1.1.0/24
10.1.1.0/24
20.1.1.0/24
5.1.1.1
10.1.1.1
10.1.1.3
20.1.1.2
20.1.1.3
10.1.1.2
20.1.1.1
A
B
C
D
Router LSA
RECEIVE ROUTER ISA FROM D
(START SEARCH)
EXECUTE NECESSARY PROCESSING,
SUCH AS COMPARING SEQUENCE NUMBER, ETC.
LSDB
LS TYPE
Link State ID
Advertising Router
LS Sequence number
Link ID (DR when Transit NW)
Link Data
Metric
1(Router LSA)
10.1.1.1
10.1.1.1
0x80000002
5.1.1.0
255.255.255.0
①
10.1.1.3
10.1.1.1
②
1
20.1.1.3
20.1.1.3
0x80000006
20.1.1.3
20.1.1.3
①
Hit

FIG.16

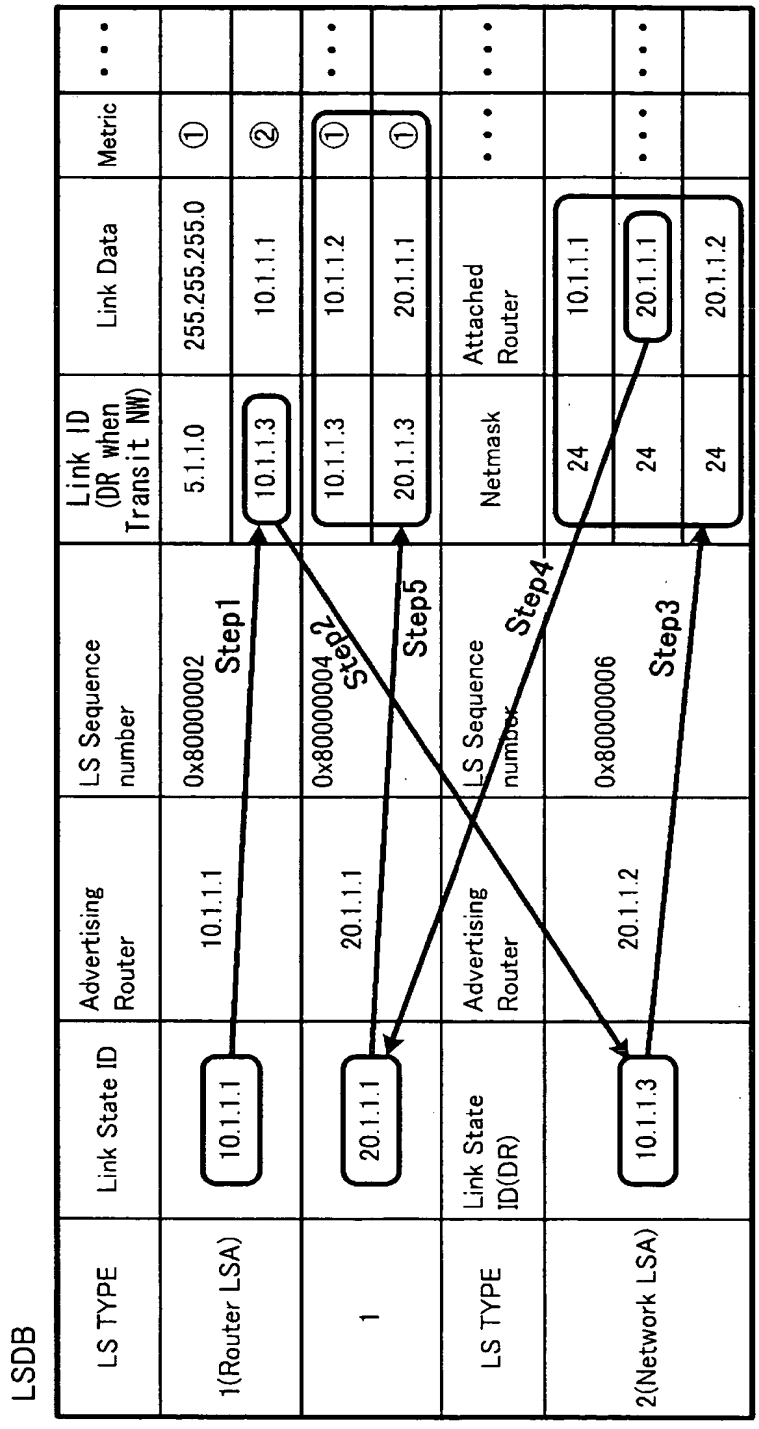
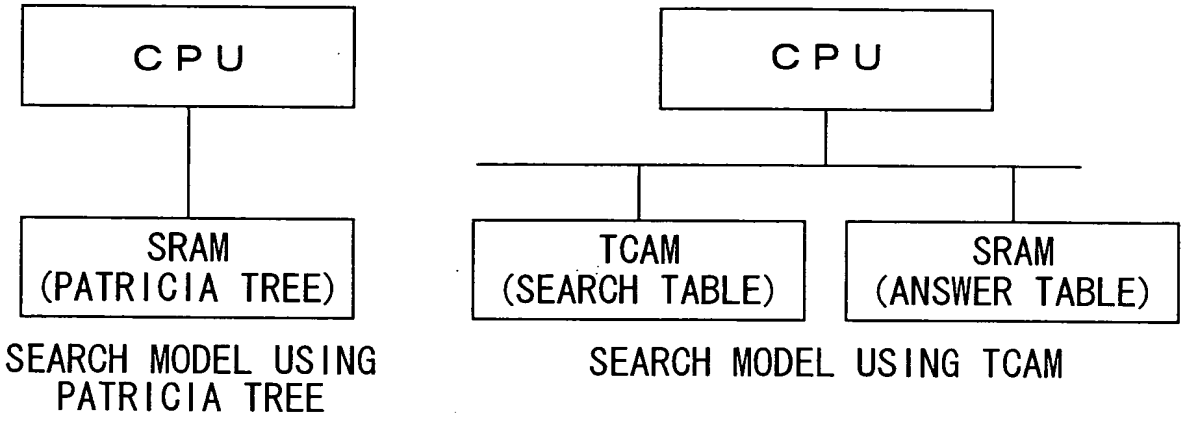

LSDB
LS TYPE
Link State ID
Advertising Router
LS Sequence number
Link ID (DR when Transit NW)
Link Data
Metric
1(Router LSA)
10.1.1.1
0x80000002
5.1.1.0
255.255.255.0
①
10.1.1.3
10.1.1.1
②
1
20.1.1.1
0x80000004
10.1.1.3
10.1.1.2
①
20.1.1.3
20.1.1.1
①
LS TYPE
Link State ID(DR)
Advertising Router
LS Sequence number
Netmask
Attached Router
2(Network LSA)
10.1.1.3
20.1.1.2
0x80000006
24
10.1.1.1
24
20.1.1.1
24
20.1.1.2
Step1
Step2
Step3
Step4
Step5

FIG.17



SEARCH MODEL USING PATRICIA TREE

SEARCH MODEL USING TCAM

(NOTE) SRAM ACCESS TIME: 5 ns, TCAM ACCESS TIME: 5 ns

FIG.18

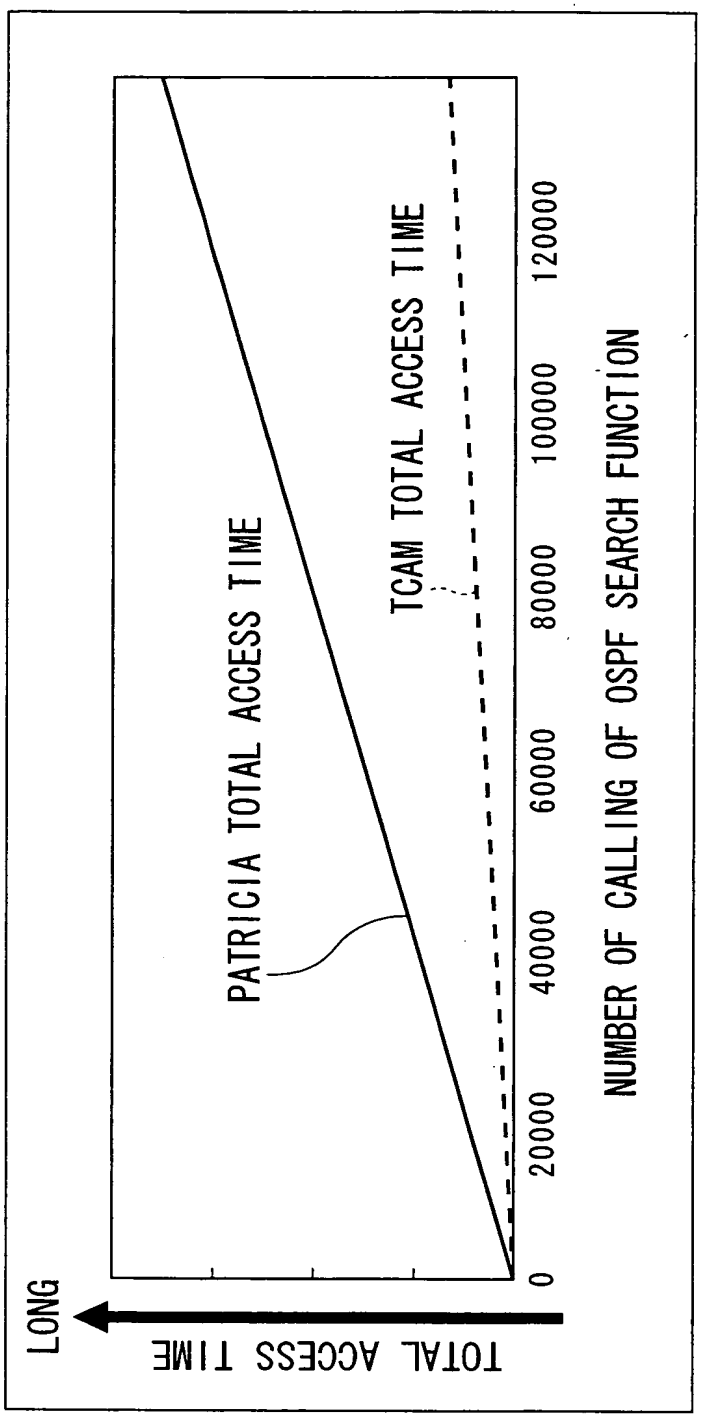

PATRICIA TOTAL ACCESS TIME
TCAM TOTAL ACCESS TIME
0
20000
40000
60000
80000
100000
120000
NUMBER OF CALLING OF OSPF SEARCH FUNCTION
TOTAL ACCESS TIME
LONG

FIG.19

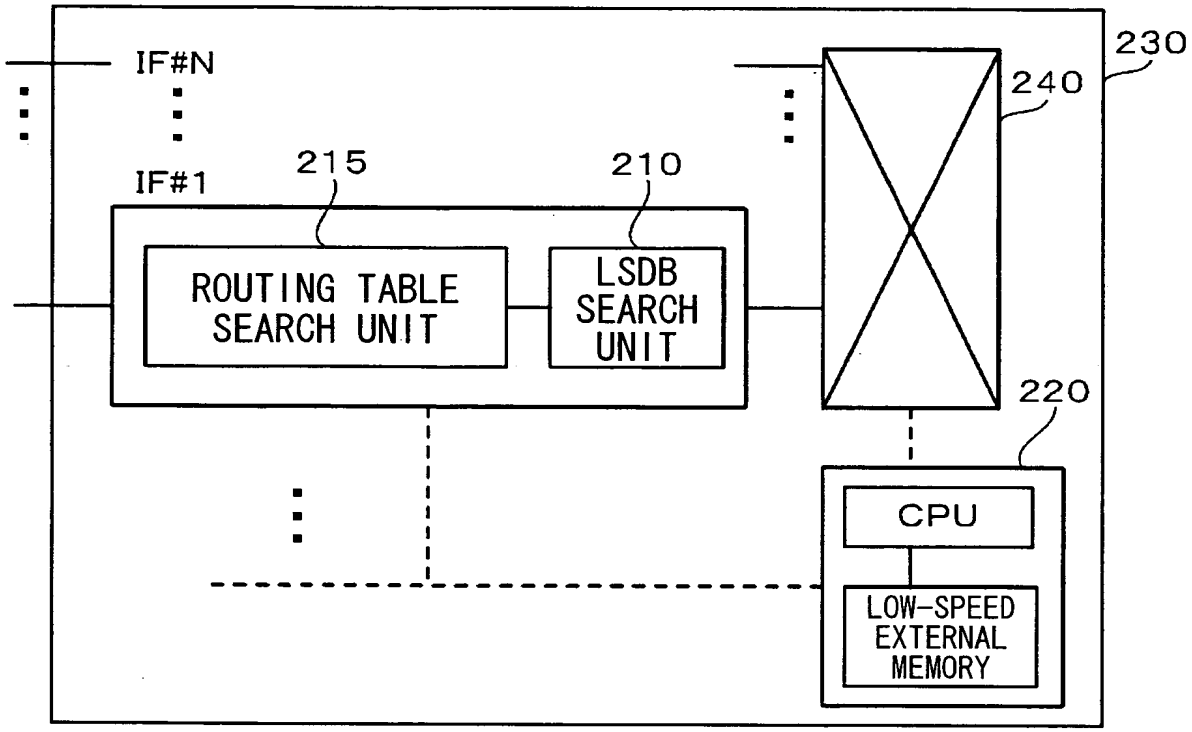

IF#N
IF#1
215
210
230
240
220
ROUTING TABLE SEARCH UNIT
LSDB SEARCH UNIT
CPU
LOW-SPEED EXTERNAL MEMORY

FIG.20

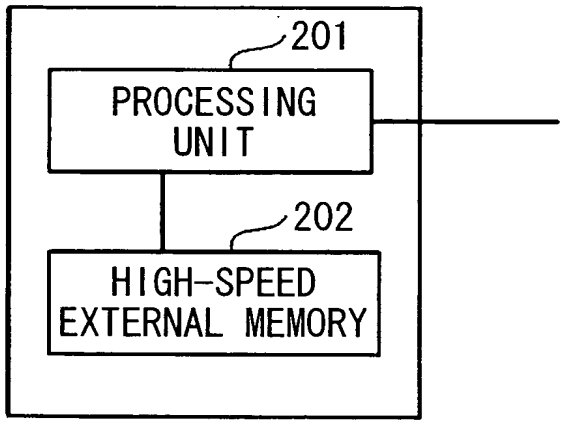

201
PROCESSING UNIT
202
HIGH-SPEED EXTERNAL MEMORY

FIG.21

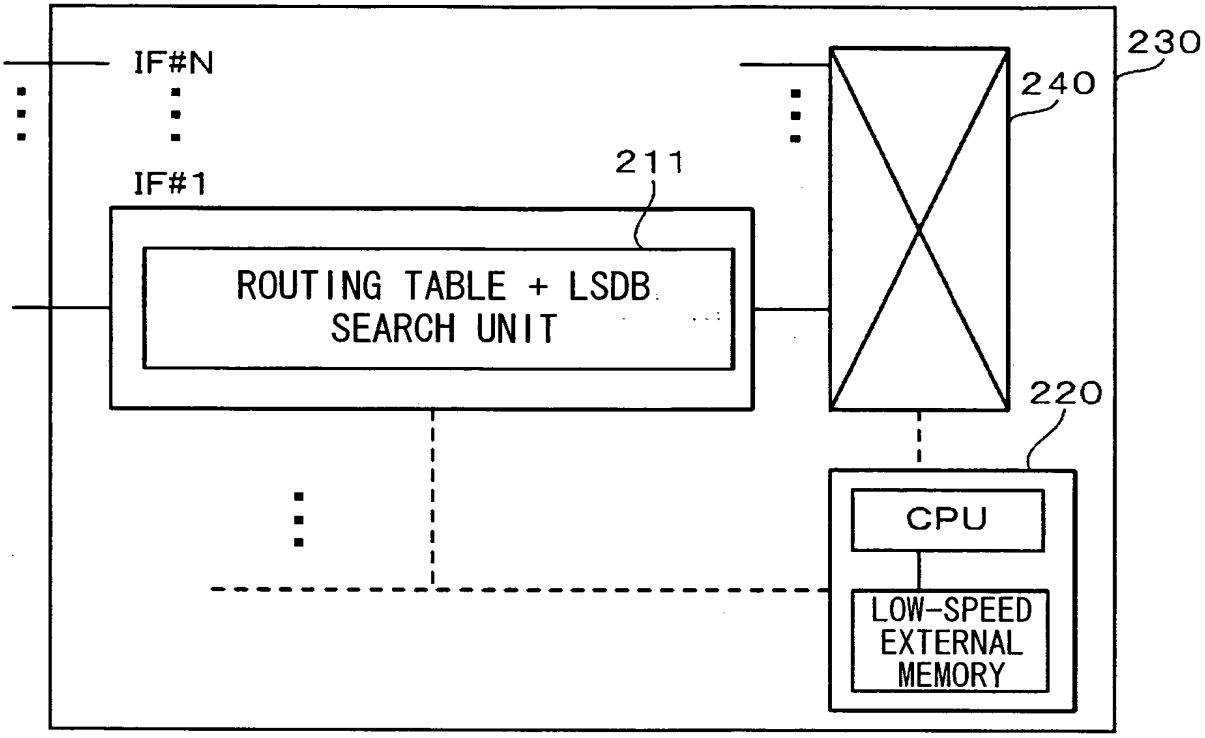

IF#N
IF#1
211
ROUTING TABLE + LSDB SEARCH UNIT
230
240
220
CPU
LOW-SPEED EXTERNAL MEMORY

FIG.22

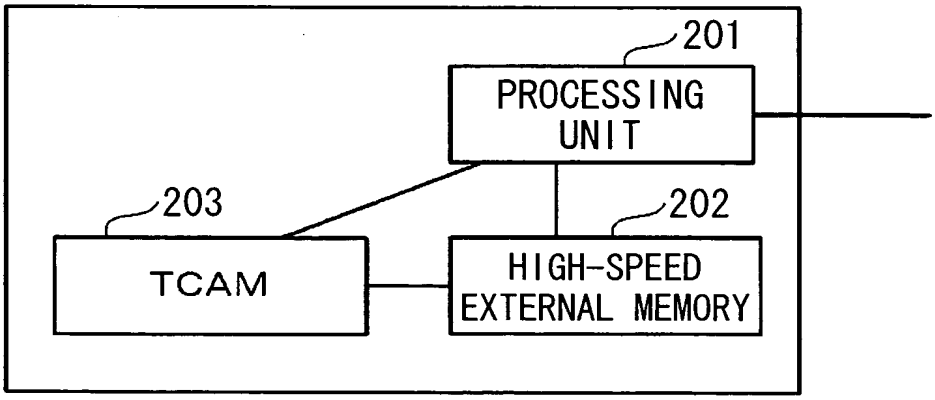

201
PROCESSING UNIT
203
202
TCAM
HIGH-SPEED EXTERNAL MEMORY

FIG.23

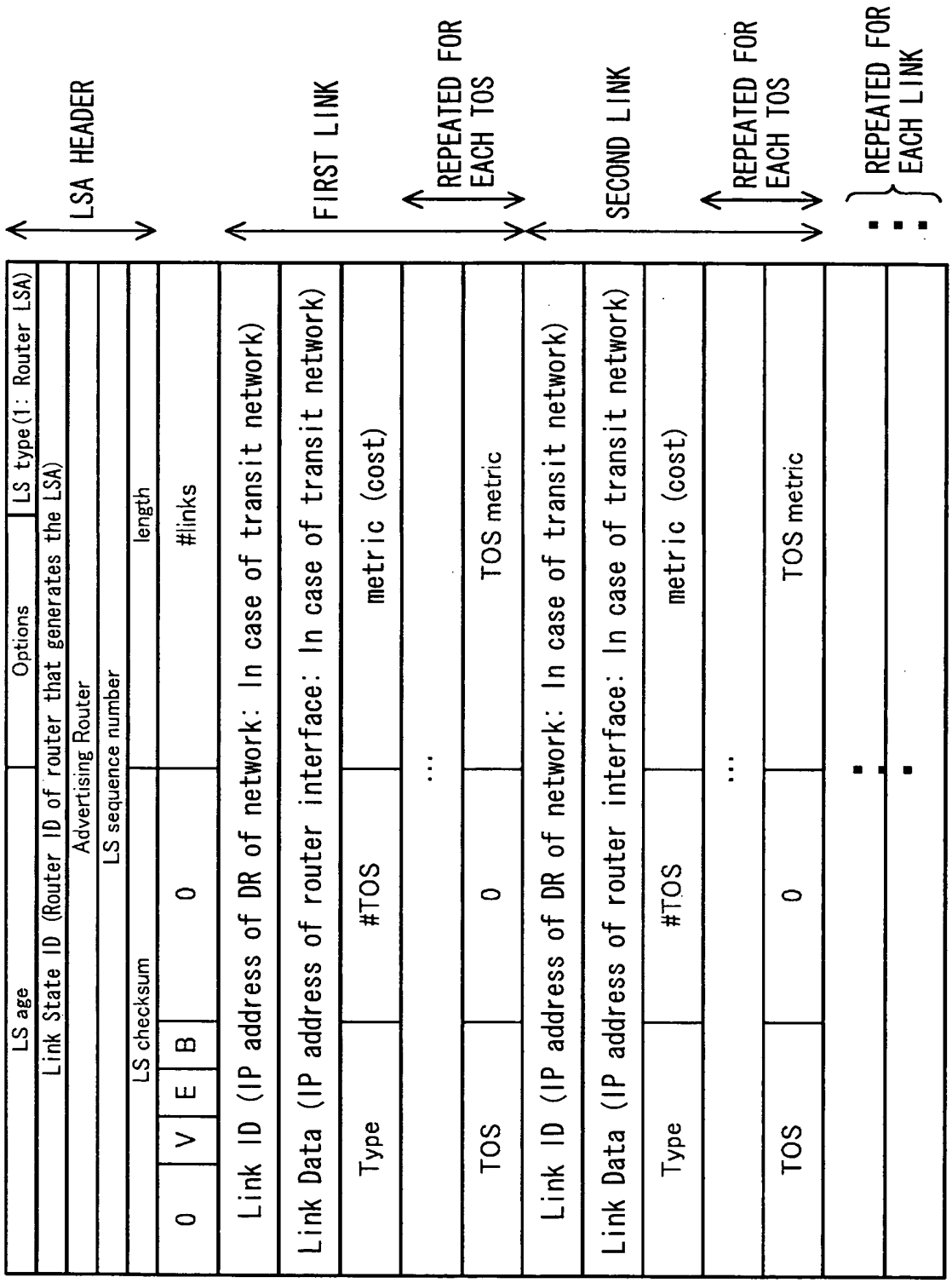

LSA HEADER
FIRST LINK
REPEATED FOR EACH TOS
SECOND LINK
REPEATED FOR EACH TOS
REPEATED FOR EACH LINK
LS age
Options
LS type(1: Router LSA)
Link State ID (Router ID of router that generates the LSA)
Advertising Router
LS sequence number
LS checksum
length
0
V
E
B
0
#links
Link ID (IP address of DR of network: In case of transit network)
Link Data (IP address of router interface: In case of transit network)
Type
#TOS
metric (cost)
...
TOS
0
TOS metric
Link ID (IP address of DR of network: In case of transit network)
Link Data (IP address of router interface: In case of transit network)
Type
#TOS
metric (cost)
...
TOS
0
TOS metric

FIG.24

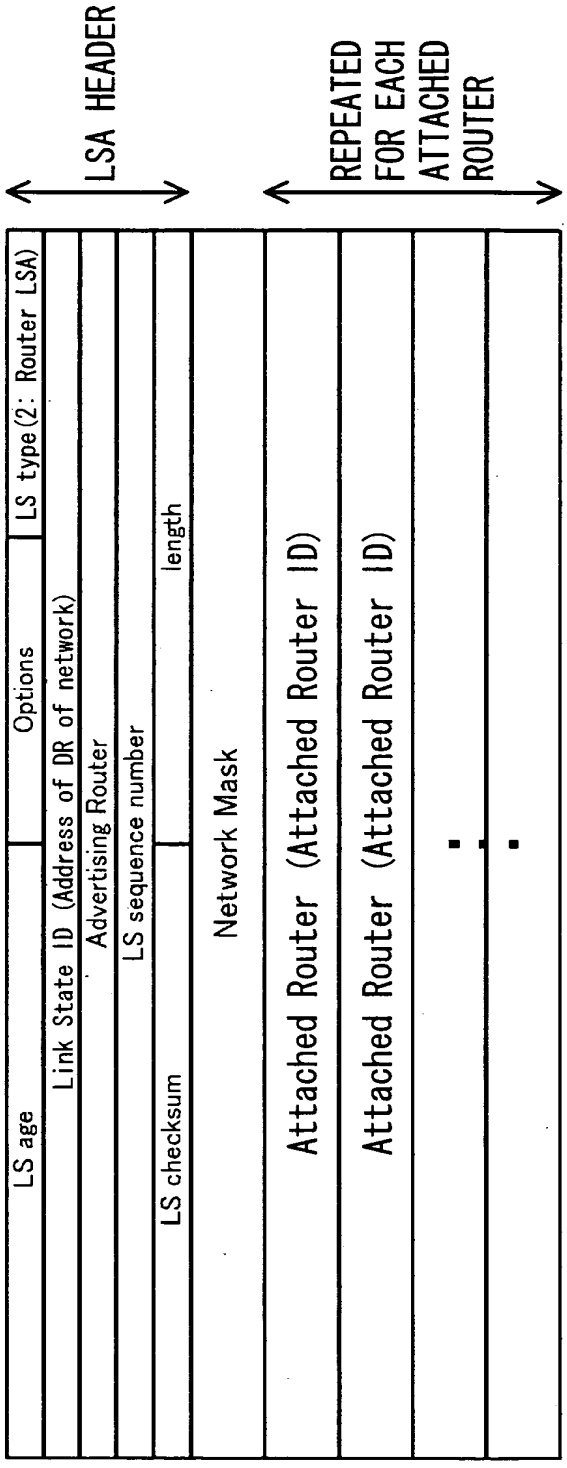

LSA HEADER
REPEATED FOR EACH ATTACHED ROUTER
LS age
Options
LS type (2: Router LSA)
Link State ID (Address of DR of network)
Advertising Router
LS sequence number
LS checksum
length
Network Mask
Attached Router (Attached Router ID)
Attached Router (Attached Router ID)

FIG.25

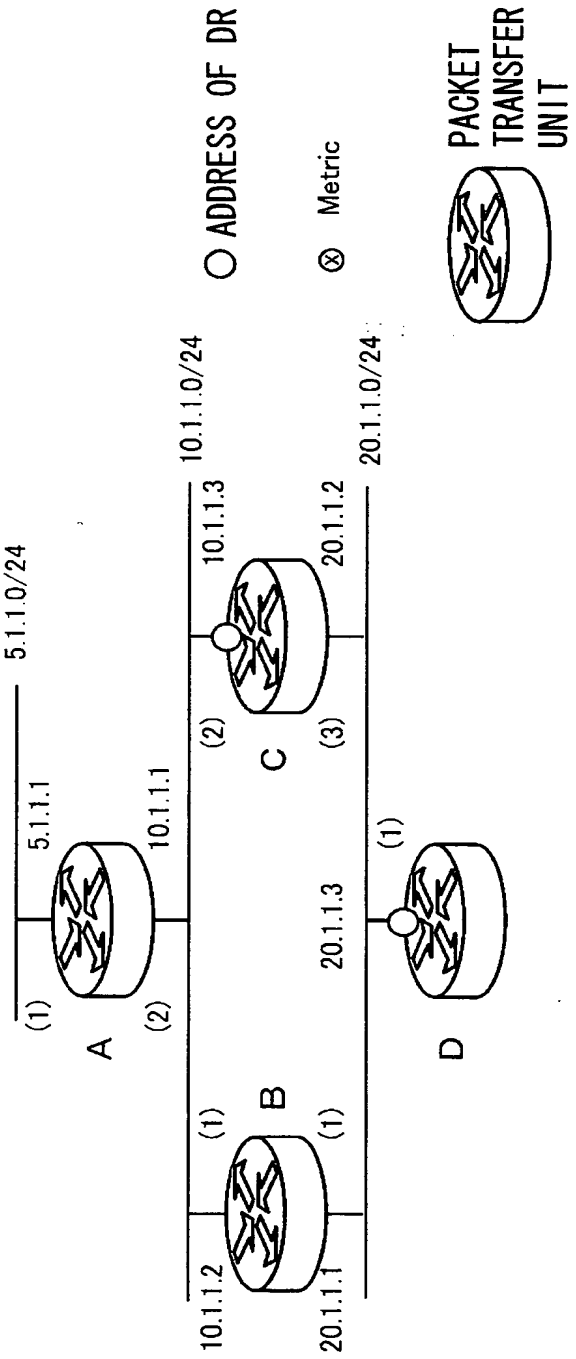

PACKET TRANSFER UNIT
⊗ Metric
○ ADDRESS OF DR
5.1.1.0/24
10.1.1.0/24
20.1.1.0/24
5.1.1.1
10.1.1.1
10.1.1.3
20.1.1.2
20.1.1.3
10.1.1.2
20.1.1.1
(1)
(2)
(3)
A
B
C
D

FIG.26

LSDB

LS TYPE	Link State ID	Advertising Router	LS Sequence number	LS checksum	LS age
1(Router LSA)	10.1.1.1	10.1.1.1	0x80000002	005	133
1	20.1.1.1	20.1.1.1	0x80000004	110	310
1	• • •	• • •	• • •	• • •	• • •
LS TYPE	Link State ID(DR)	Advertising Router	LS Sequence number	LS checksum	LS age
2(Network LSA)	10.1.1.3	20.1.1.2	0x80000008	115	218
2	• • •	• • •	• • •	• • •	• • •
• • •					

ITEMS UNIQUELY IDENTIFYING INFORMATION

LS SEQUENCE NUMBER, ETC.

FIG.27

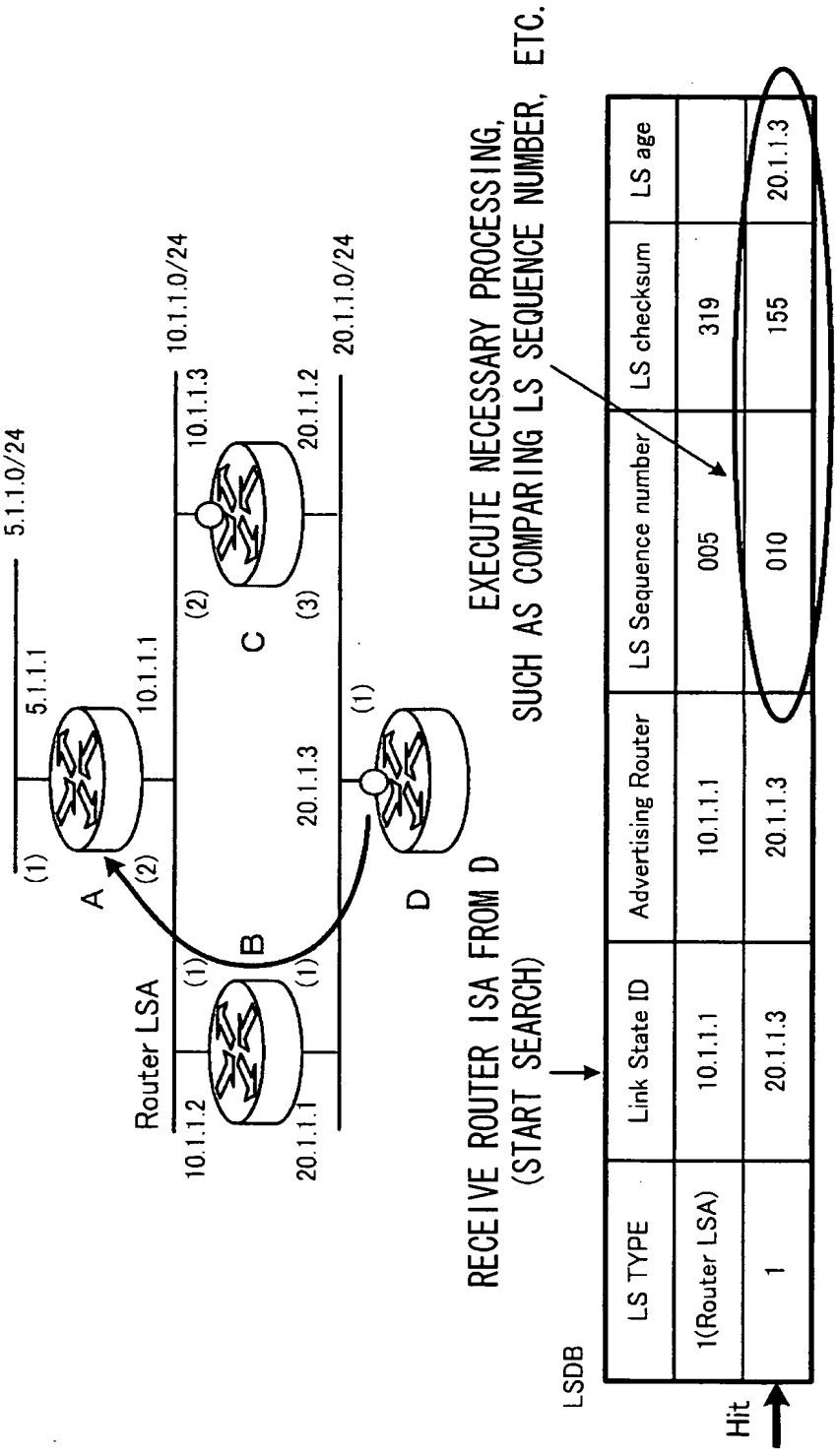

5.1.1.0/24
10.1.1.0/24
20.1.1.0/24
5.1.1.1
10.1.1.1
10.1.1.3
20.1.1.2
20.1.1.3
10.1.1.2
20.1.1.1
(1)
(2)
(3)
A
B
C
D
Router LSA
RECEIVE ROUTER ISA FROM D
(START SEARCH)
EXECUTE NECESSARY PROCESSING,
SUCH AS COMPARING LS SEQUENCE NUMBER, ETC.
LSDB
Hit
LS TYPE
Link State ID
Advertising Router
LS Sequence number
LS checksum
LS age
1(Router LSA)
10.1.1.1
10.1.1.1
005
319
1
20.1.1.3
20.1.1.3
010
155
20.1.1.3

FIG.28

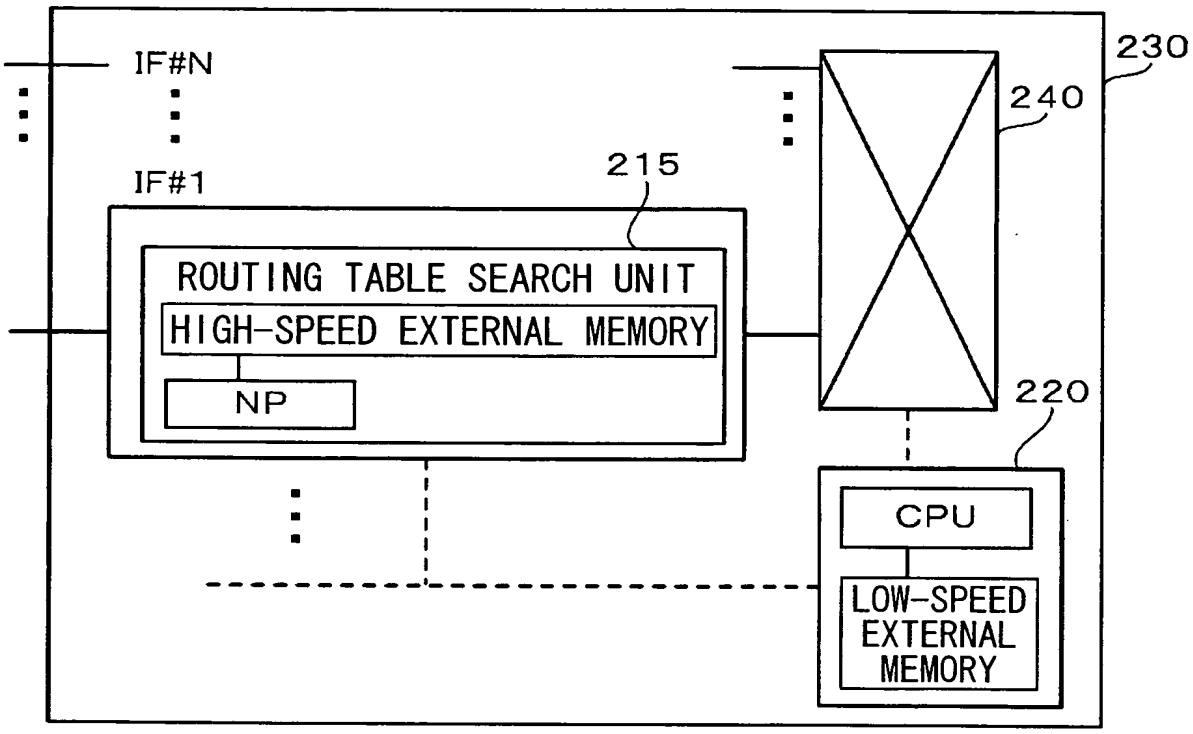
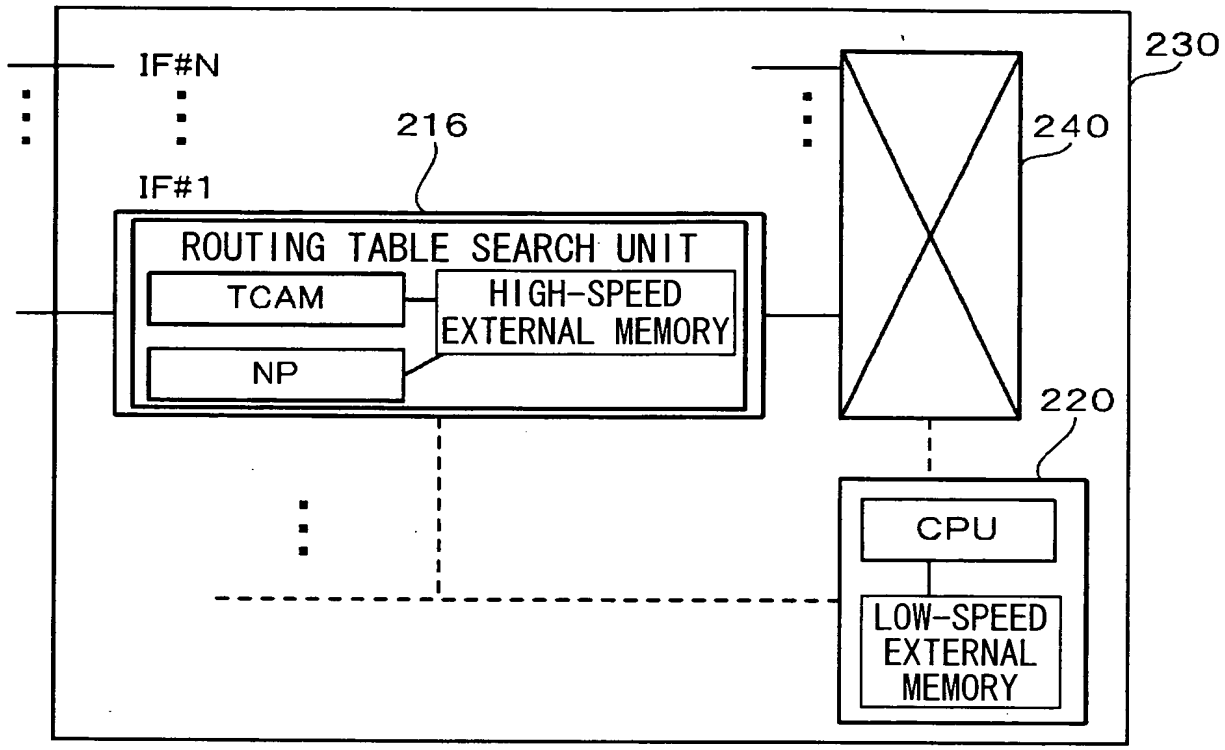

IF#N
IF#1
215
ROUTING TABLE SEARCH UNIT
HIGH-SPEED EXTERNAL MEMORY
NP
230
240
220
CPU
LOW-SPEED EXTERNAL MEMORY

FIG.29


IF#N
IF#1
216
ROUTING TABLE SEARCH UNIT
TCAM
HIGH-SPEED EXTERNAL MEMORY
NP
230
240
220
CPU
LOW-SPEED EXTERNAL MEMORY